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# WATER-SOLUBLE PROTEIN MATERIALS

Akiva Pour-El, St. Paul, and Thomas C. Swenson, Minneapolis, Minn., assignors to Archer Daniels Midland Company, Decatur, Ill.

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U.S. Cl. 99—79 13 Claims

## ABSTRACT OF THE DISCLOSURE

Dispersed plant proteins are digested with an acid active enzyme at a pH below 4.6. Quiescent conditions are maintained in the reaction medium and digestion proceeds until the insoluble colloidal protein is substantially completely dissolved. The pH is raised to about 4.6 and the medium is allowed to stand causing additional insoluble protein to precipitate. The insoluble residue is removed and the soluble protein material is dried. A clear liquid, which can be carbonated, is formed containing the solubilized protein material at a pH corresponding to the isoelectric point of the protein.

This application is a continuation-in-part of our prior copending application Ser. No. 797,669, filed Feb. 7, 1969 and now abandoned in favor of continuation case Ser. No. 203,443, filed Nov. 30, 1971, now U.S. Pat. 3,713,843.

This invention relates to acid soluble proteins and particularly to water soluble plant proteins which are adapted for use in liquids at the pH corresponding to the isoelectric point of the starting materials. Particularly significant embodiments of the invention relate to beverages which contain a modified soybean protein in clear solution.

Many efforts have been made in the recent years to develop high protein food materials which are adapted for specific nutritional aims. Particularly pertinent among these developments are the so-called "health" foods which are adapted to reduce the consumption of carbohydrates while maintaining the nutritional value of the products consumed. One particular problem with these solutions is that proteins which are used to supply the required nutritional values are generally insoluble or only partially soluble in the beverages as marketed. Since the consumer generally requires not only a product which is nutritionally acceptable, but one which is aesthetically acceptable, it has been desirable to produce beverages in the form of clear solutions. Thus, the consumer is attracted by the combined nutritional value of the product and the clean, clear appearance of the product. For reasons other than consumer attraction, it is also desirable to have clear solutions for ease in packaging. Processing equipment can be adapted much more readily to handle solutions than to handle dispersions or emulsions since the latter tend to form sediments which clog flow lines and pumps.

In the past, proteins have not been adapted for use in liquids having acid pH since they do not completely dissolve to form sparkling clear aqueous solutions at acid pH especially at the pH of their isoelectric point. Simple proteins, e.g. globulins, are insoluble in aqueous solutions and even the relatively soluble secondary and primary digestion products of simple proteins, e.g. proteoses and peptones, do not dissolve enough to give clear solutions. Additionally, proteins vary in their solubility characteristics. Generally, proteins are least soluble at their isoelectric point which is the pH at which proteins are electrically neutral. As the pH is changed from the isoelectric point to more acid or more alkaline values, the protein



becomes relatively more soluble. This is true of the generally insoluble plant globulins (simple proteins) and of the relatively soluble peptones and proteoses, etc. (primary and secondary split-products). The increased solubility at acid or alkaline pH is generally thought to be caused by the formation of proteinates or protein-salts which are soluble salts of proteins formed by the reaction of the ionizable groups in the protein molecule with ions produced by the base or acid, respectively. However, it will be apparent that since the cationic content of the protein is generally low, it has not been possible to obtain substantially complete solubility of the protein by adjusting the pH. It is further apparent that extremely acid or extremely basic solutions are not adapted for consumption. Thus, even though conversion of plant globulins to lower derivatives generally increases the protein solubility and even though decreasing pH further increases solubility, it has not been possible to produce sparkling clear solutions of proteins at pH's especially in the range of their isoelectric points since the increased solubility is not adequate and since proteins are difficult to dissolve due to physical parameters.

In the prior art production of acid soluble protein there is usually a step in which the protein solution is kept in the cold at the pH of digestion to precipitate all the larger insoluble protein molecules prior to filtration of the digested protein. However, the resulting products were also insoluble or only partially soluble and this "winterization" required long periods.

Accordingly, it is the primary object of the present invention to provide a protein which is adapted for forming sparkling clear solutions at acid pH's.

Another object is to provide a process for forming the acid-soluble proteins from plant globulins, particularly from soybean protein.

Still another object is to provide a process for forming acid soluble protein by reacting an insoluble protein with an acid active enzyme at acid pH followed by a chemical winterization step achieved in less time.

Still another object is to provide a process which is comprised of treating an insoluble plant protein at a pH of about 3 followed by raising the pH to about 4.6 for 1–6 hours at 0° C. room temperature.

Yet another object of the invention is to provide a beverage which is adapted to have an acid pH and to contain in a sparkling clear solution up to 20% of a modified plant globulin.

Still another object is to provide a process for converting insoluble soybean proteins into a substantially completely acid soluble protein with greater ease of dissolution.

These objects are accomplished in accordance with the present invention by treating a dispersed plant globulin with an acid active enzyme at acid pH with controlled agitation wherein the enzyme digests the plant proteins in colloidal suspension and produces a protein which is approximately 100% soluble in the reaction medium and wherein the pH of the reaction medium is then raised to about 4.6 by adding a basic medium for 1–6 hours at 0° C. to room temperatures. The invention thus involves a proteolysis performed at a specific pH range followed by a chemical winterization at pH 4.6.

It will thus be seen that the present invention provides a method for treating the simple proteins (globulins) with enzymes to digest such simple proteins and form the primary and secondary split-product derivatives thereof. These derivatives are proteins of a less complex nature and their digested products, which upon digestion by alimentary enzymes, will yield amino acids adapted for assimilation in the body. The treatment in accordance with the present invention facilitates solutions of proteins in